



Has the world survived the population bomb? A 10-year update

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Abstract

Between 1960 and 2011, world population grew from 3 to 7 billion, an unprecedented rate of population growth that will never be seen again. In spite of the addition of 4 billion people in just 51 years, the world experienced some of the biggest improvements in living standards in human history, with declines in poverty and improvements in food production per capita in all major regions. This paper looks at the period since 2011, during which the world added another billion people. Progress has continued in many areas, with food production continuing to grow faster than population and with continued declines in the proportion of the population in poverty in all regions. Not all trends are positive, however. Progress in food production has slowed, with recent declines in food production per capita in Africa. Prices of food and other commodities have recently hit historic highs. Climate change is a challenge to progress in combatting hunger and poverty, especially in Africa. While climate change will make it harder to meet the needs of Africa's continued population growth in this century, the paper shows that the countries with the highest population growth account for a very small share of global CO₂ emissions. The record of the last six decades suggests that progress can be made to reduce poverty and hunger, even while world population continues to grow, but continued progress will require solutions to climate change that mainly target high-income and middle-income countries.

Keywords Population growth · Food production · Poverty · Food prices · Climate change

Introduction

In my 2011 Presidential Address to the Population Association of America (Lam, 2011), I looked at trends in a number of demographic and economic variables over the previous 50 years. During the period in which the world grew from 3 billion in 1960 to 7 billion in 2011, an unprecedented rate of population growth that

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will almost surely never be seen again, the world experienced some of the biggest improvements in standards of living in human history. I showed that food production grew faster than population in every major region between 1961 and 2009. Poverty declined in every region, though declines were smaller in Africa than in Asia. The price of food and other commodities fell for most of the period, although prices increased sharply from 2000 to 2010. My interpretation of this history was that it was a period of surprising success, with the world adding 4 billion people while also improving standards of living in many of the poorest countries in the world and avoiding major resource scarcities.

This paper looks at what has happened since 2011 in a number of key indicators, including food production, poverty, and food prices. Many of the trends have continued to be positive, with food production continuing to grow faster than population and with poverty continuing to decline in all regions. Not all trends are positive, however. The growth rate of food production has slowed in some regions, and there have been sharp increases in the price of food and other commodities since 2020. Climate change increasingly threatens progress in reducing hunger and poverty, especially in Africa. The following sections review these trends, discuss recent increases in prices, and look at the role of population growth in climate change.

From 7 to 8 billion people

The world's current demographic situation looks similar to what was projected in 2011. The world's population growth rate, which was 1.2% per year in 2011, has fallen below 1% per year for the first time since 1950 and is projected to continue falling throughout the century (UN 2022).¹ The total fertility rate (TFR) for the world fell from 2.6 in 2011 to 2.3 in 2022, continuing the steady decline from its level of 5.0 in the 1950s. Africa continues to have relatively high fertility, but the TFR in Africa fell from 4.8 in 2011 to 4.2 in 2022.

The world added roughly one billion people between 2011 and 2023, going from 7 to 8 billion. This is somewhat faster growth than projected by the UN in 2011, when the medium variant projection showed world population reaching 8 billion in 2025. The components of this additional one billion people are worth noting. Figure 1 shows the components of the additional one billion people added between 1960 and 1974, when the world grew from 3 to 4 billion, and compares this to the components of the additional one billion added between 2011 and 2023. Figure 1 shows that the world in 1974 had 356 million more children (0–14), 552 million more working age (15–64), and 68 million more elderly (65+) than the world in 1960, a total increase of 976 million. The additional 976 million consisted of 648 million people in Asia, 122 million people in Africa, 96 million people in Latin

¹ Population estimates and projections are based on the United Nations Population Division's World Population Prospects 2022. Projections are based on the UN's "Medium Variant" projections.

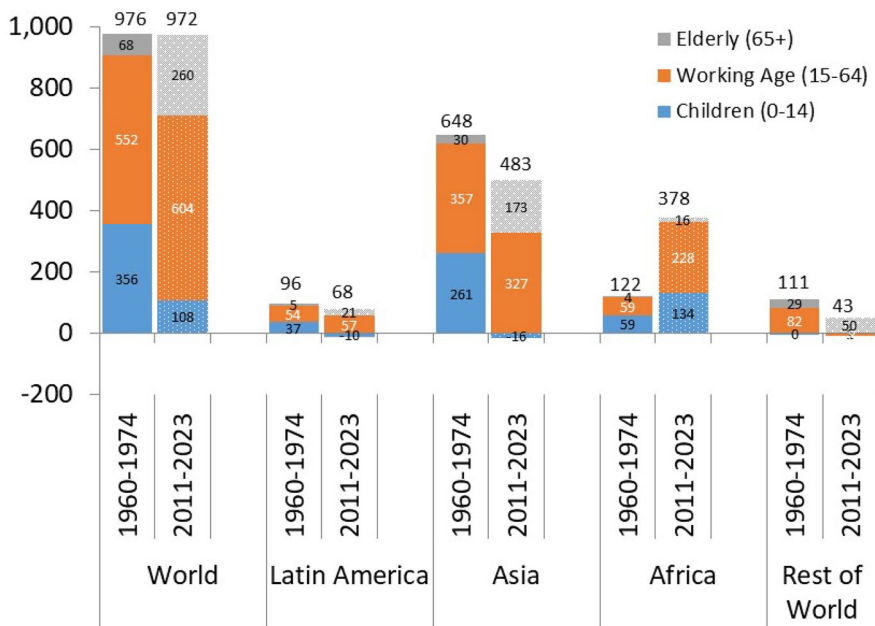


Fig. 1 Decomposition of one billion increase in world population 1960–74 and 2011–2023. Source: Constructed using data downloaded from United Nations Population Division (2022)

America, and 111 million people in the rest of the world. The 972 million people added between 2011 and 2023 look different in a number of ways. There are only 108 million additional children, with absolute declines in the number of children in Asia and Latin America. There are 260 million additional elderly, over four times the increase that occurred between 1960 and 1974, with 174 million additional elderly in Asia. Asia was still the largest contributor to the total population change, but Africa's contribution increased dramatically, from 122 million in 1960–1974 to 378 million in 2011–2023. Going forward, Africa will be the only region with significant population growth and the only region with a growing working-age population for most of this century (Lam et al., 2019, UN 2022).

Food production, food prices, and the Becker-Lam wager

As noted in Lam (2011), a major concern about population growth in the 1960s was that population would grow faster than food production in low-income countries, creating mass starvation and high mortality. I showed that food production actually

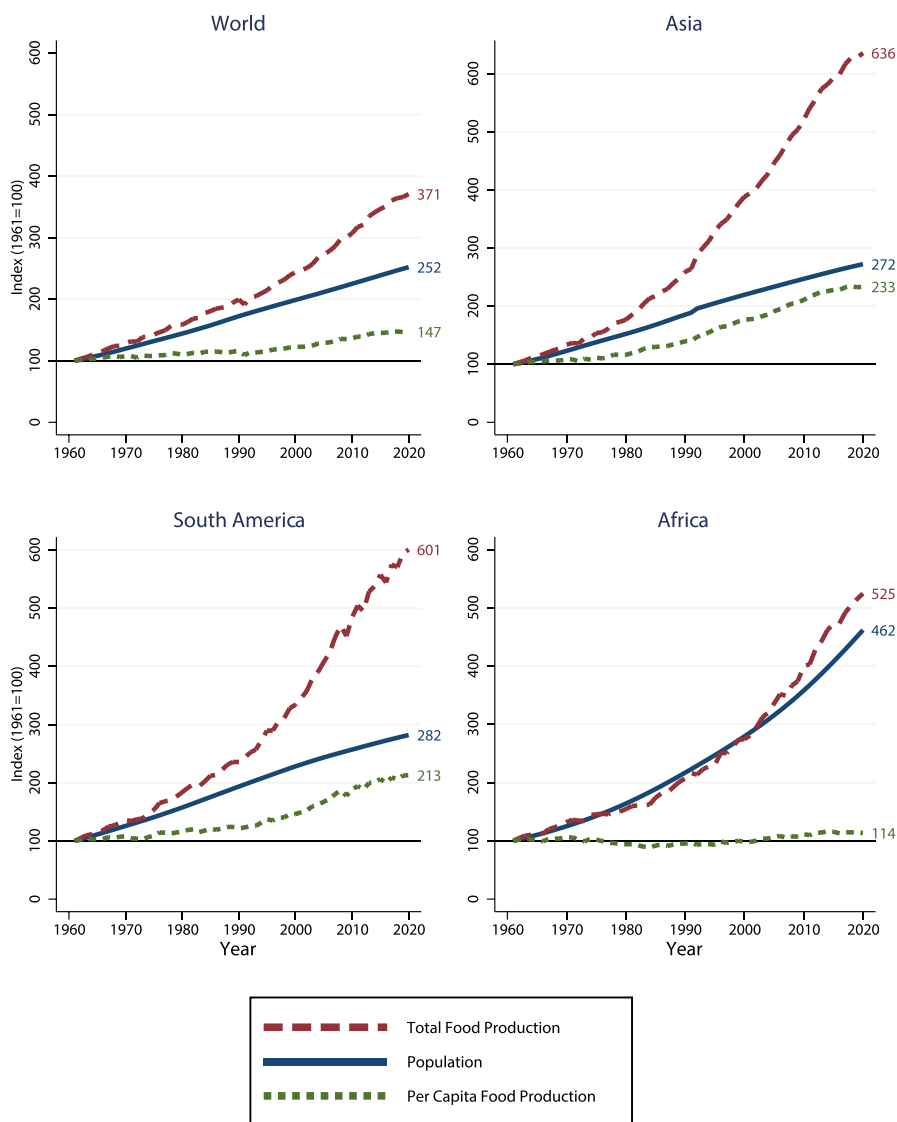


Fig. 2 Indices of food production, population, and per capita food production, 1961–2020. Indices normalized to 1961=100. *Source:* Constructed using data downloaded from Food and Agriculture Organization of the United Nations (2022)

grew faster than population for all major regions for the period 1961–2010 (Lam, 2011). An important question is whether this reassuring trend has continued.

Figure 2 shows trends in food production, population, and food production per capita for the world, Asia, South America, and Africa from 1961 to 2020, with

each series indexed at 1961 = 100.² For the world as a whole, population increased 2.5 times from 1961 to 2020, while food production increased 3.7 times, implying that per capita food production was 47% higher in 2020 than in 1961. While per capita food production has continued to increase since 2011, the rate of increase has slowed. From 1990 to 2011, per capita food production for the world grew at 0.9% per year, faster than the rate of growth from 1961 to 1989. Per capita food production grew at 0.6% per year in the period 2012–2020, but only grew at 0.3% per year in the period 2015–2020. In Africa, per capita food production only grew at 0.4% per year in 2012–2020, down from 0.6% per year in 1990–2011. For the period 2015–2020, per capita food production in Africa actually fell at a rate of –0.4% per year. Since population growth rates have been declining, it is declines in the growth rate of food production that is driving the slower growth of per capita food production.

Africa's record in food production over the last 60 years is in many respects quite impressive. In 2020, the continent was producing 5.3 times more food than it was in 1961, a considerably higher rate of growth than for the world as a whole. The challenge in Africa is that population in 2020 was 4.6 times its 1961 level, offsetting much of the increase in food production. Yields in Africa remain below those of most other regions, and have grown more slowly than in other regions. Jayne and Sanchez (2021) estimate that 75% of Africa's increased agricultural output since 2000 came from expansion of area under cultivation, with only 25% due to increased yields. Increasing yields is essential if Africa is going to succeed in feeding the population that will be added in this century. Climate change is putting pressure on productivity in agriculture, especially in Africa, with weather extremes playing a role in the slower growth of food production in Africa in recent years (Fuglie et al., 2021; FAO, Eca and AUC, 2021).

An important caveat regarding measures of food production such as those in Fig. 2 is that they are not necessarily a good measure of food consumption within regions or individual countries, especially food consumption of the poorest segments of the population. Food produced in a country may be exported outside the country, and food that remains in the country may be very unequally distributed. The encouraging signs in Fig. 2 about food production outpacing population over the last 60 years do not necessarily mean that poverty and hunger are being reduced. Fortunately, we have more direct measures of poverty that can be used to address the question of food consumption and hunger at the bottom of the income distribution. As will be discussed below, these poverty estimates imply that the increased per capita food production shown in Fig. 2 does in fact translate into increased food consumption for the poorest parts of the population in all regions.

² Data are taken from the FAOSTAT database of the Food and Agriculture Organization of the United Nations (FAO 2023a). The FAO constructs a food production index using data for a wide range of individual food items. Individual items are aggregated using 2004–2006 international prices to construct a set of weights that are held constant over time (a Laspeyres index). It is an index of the economic value of total production of food items, valued at 2004–2006 international prices. It is not an index of the caloric value of food production. See FAO (2023b) for details. Food production per capita is total food production divided by the mid-year population. In Fig. 2, the values for food production, population, and food production per capita are normalized so that 1961 = 100 for each series.

Food prices and the Becker-Lam wager

Food production is closely related to food prices, although the link is far from perfect given other factors affecting food prices, including the cost of inputs (especially energy), disruptions in trade, and speculation in commodity markets. Looking at trends in food prices since 1961, Lam (2011) showed that food prices tended to fall from 1961 to 2000 and then increased rapidly from 2000 to 2010. In the oral presentation of my presidential address, I offered to wager that the price of food would not continue this rapid increase, but would soon begin to fall. Professor Stan Becker of Johns Hopkins University accepted this offer and proposed a wager based on the average price of food from 2001 to 2010 compared to the average price of food from 2011 to 2020. A summary of the wager, along with observations from Becker and me, can be found in Becker and Lam (2022).

Figure 3 shows the FAO Food Price Index, a measure of the international price of a basket of food commodities. Prices are indexed to 2011 = 100. The figure shows the real (inflation adjusted) index, following the approach used in the Becker-Lam wager. The figure shows the annual index for 1960 through 2000 and the monthly index from January 2001 through January 2023. The baseline period for the Becker-Lam wager, Jan. 2001–Dec. 2010, is shown in blue. The comparison period for the wager, Jan. 2011–Dec. 2020, is shown in red.

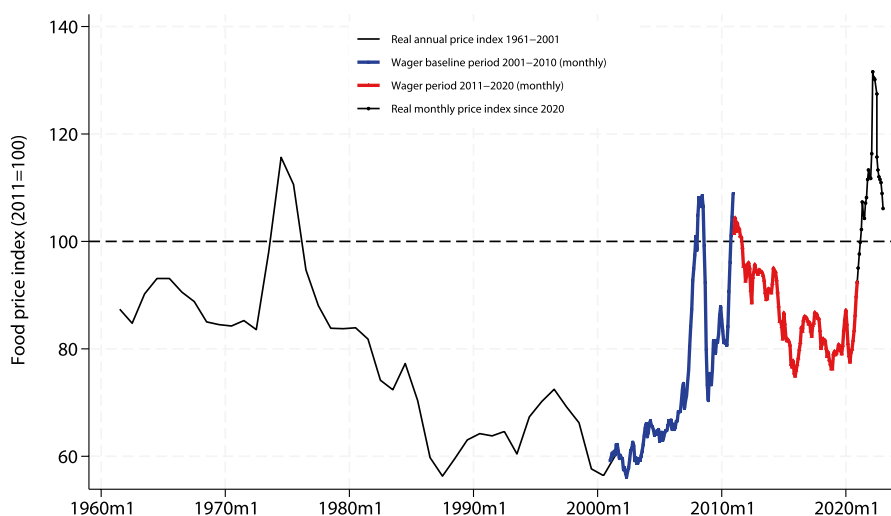


Fig. 3 Food and agriculture organization real food price index, 1961–2022. Prices normalized to 2011 annual average equals 100. *Source:* Constructed using data downloaded from United Nations Food and Agriculture Organization (2023)

As seen in Fig. 3, the price of food tended to decline from 1961 through 2000, disrupted by the mid-1970s spike in oil prices, with an increase and subsequent decrease in the 1990s. The world price of food in 2000 was 35% lower than in 1961. Food prices went up dramatically between 2000 and 2011, rising more than 75% over the period.

The price of food began to decline after 2011, consistent with the prediction in my presidential address. Prices leveled off around 2015, however, and the overall price decline in the 2011–2020 period was not enough to offset the price increase that occurred between 2001 and 2010. The average price for 2011–2020 was higher than the average price for 2001–2010. This pattern held for each of the five food groups included in the Becker-Lam wager, with the result that \$200 worth of each of the five items purchased at 2001–2010 prices would have cost an average of \$1194 using 2011–2020 prices (an increase of \$194). As agreed to in the wager, I donated \$194 to an organization of Professor Becker's choosing.

After the end of the wager there was a sharp increase in food prices. As shown in Fig. 3, the monthly food price index began a steep increase in mid-2020 as a result of disruptions caused by the COVID-19 pandemic. Price increases of around 3% per month were common starting in mid-2020. Monthly food prices reached a peak in March 2022, exceeding the previous peak of the 1970s. Prices have fallen rapidly since the March 2022 peak. It is difficult to predict what will happen in coming months, especially given disruptions in food production and food exports caused by the war in Ukraine. As seen in Fig. 3, the current price level is still above its 2011 level, although the recent trend is sharply downward.

Are the record high food prices of 2022 a sign of long-run higher prices? While some factors, such as climate-change related droughts, may reflect long-term challenges in agricultural production, the main drivers of recent price spikes are disruptions to production and distribution caused by the COVID-19 pandemic and more recent disruptions related to war in Ukraine. As was seen during the sharp price increases in the 2000–2010 period, global food prices are very sensitive to short-run disruptions in international markets. In the longer run, production tends to be stimulated by rising prices, leading to an eventual moderation in prices. The long-term trend continues to be that food production is growing faster than population. As long as that trend continues, the high food prices in the aftermath of COVID-19 are unlikely to represent a long-term shift to higher prices (World Bank, 2022).

Other commodity prices

Trends in food prices are similar to trends in other commodity prices. As noted in Lam (2011), the prices of many commodities, including metals and other non-renewable resources, were on a falling trajectory from the late 1970s to 2000 and then increased sharply around 2000. The period of falling prices included the period covered by the well-known wager between Julian Simon and Paul Ehrlich, discussed in Lam (2011).

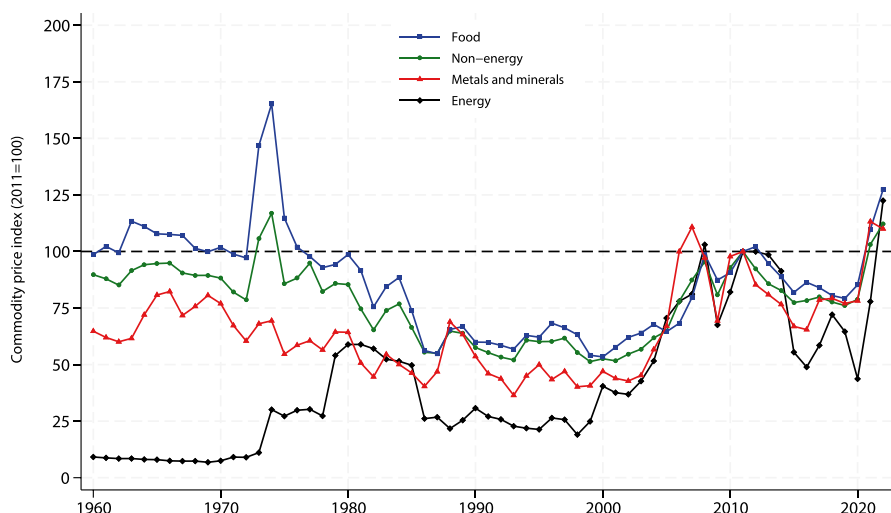


Fig. 4 Indices of real commodity prices, 1961–2022. Prices normalized to 2011=100. *Source:* Constructed using data downloaded from World Bank Commodity Markets “Pink Sheet” (World Bank (2023b))

Figure 4 shows price indices for several commodity categories — energy, non-energy, food, and metals/minerals.³ The prices are normalized to 2011=100. All of the series can be summarized roughly as follows: Prices are roughly flat through the 1960s, with a spike in the mid-1970s, followed by significant declines through the 1980s and 1990s, sharp increases from 2000 to about 2011, declines from 2011 to 2019, and sharp increases beginning in 2020.

The fact that non-agricultural prices such as metals and minerals have experienced similar spikes as food prices suggests that climate change is unlikely to be the primary driver of recent increases in food prices. As occurred during the 2000–2010 period, prices have risen for a wide range of commodities, suggesting that factors such as disruptions in global trade, general disruptions in production, and rising energy prices (which affect the prices of other commodities) are driving short-term price increases. Just as all these prices began to decline around 2011, it seems plausible that prices of all these commodities will begin to fall once markets recover from these disruptions (World Bank, 2022).

³ Prices are taken from the World Bank’s “pink sheet” of commodity prices, using commodity categories provided in the data (World Bank 2023b). Individual commodity prices are aggregated into indices for broader categories (food, energy, etc.) using weights based on the share of each item in the value of total consumption for that category in a reference year.

Trends in poverty rates

Another major concern in the 1960s about rapid population growth was that it would lead to increases in the percentage of the population in poverty in low-income countries. At the time of my 2011 address, the best estimates of poverty were the World Bank's estimates, which covered the period 1981–2005. Using the World Bank's estimates of the proportion of the population below the “extreme poverty” line of household per capita consumption of US\$1.25 per day, I showed that the percentage of the population in poverty in low-income and middle-income countries fell from 52% in 1981 to 25% in 2005. Progress in poverty reduction varied by region, with the fastest declines in East Asia and the slowest declines in Sub-Saharan Africa (Lam, 2011). Because these poverty estimates are based on consumption (including self-subsistence), they are informative about the extent to which hunger is rising or falling in a given country or region. Food is the key component of consumption for the poorest households in the world, so a decline in the rate of extreme poverty implies that food consumption is increasing at the bottom of the distribution.

The World Bank continues to provide the best measures of poverty. Its latest estimates use an extreme poverty line of household per capita consumption of US\$2.15 per day in 2017 prices (roughly equivalent to the previous \$1.25 per day measure, adjusting for inflation), covering the period 1981–2019 for most regions. The World Bank now estimates the percentage of the population in poverty for the entire world as well as for individual countries and regions. The top panel of Fig. 5 shows extreme poverty rates for the world and four major regions — South Asia, East Asia, Latin America and the Caribbean, and Sub-Saharan Africa. The line at 2005 indicates the end of the data presented in Lam (2011).

As seen in Fig. 5, poverty rates have continued to decline in all regions. For the world as a whole, poverty fell from 44 to 22% from 1981 to 2005 and declined from 22 to 8% from 2005 to 2019. In Sub-Saharan Africa, the poverty rate fell from 53% in 1990 to 49% in 2005, with a faster decline from 49 to 35% between 2005 and 2019.

Given continued population growth in all regions, declines in the percentage of the population in poverty do not necessarily translate into declines in the absolute number of people in poverty. The bottom panel of Fig. 5 shows an index of the absolute number of people in poverty, setting the 1990 value to 100 for each region (1990 is the first year with data for all regions). For the world as a whole, the decline in the proportion in poverty has been fast enough to offset population growth. The total number of people in extreme poverty in the world fell by over 25% between 1981 and 2005 and fell by another 50% between 2005 and 2019. East Asia, South Asia, and Latin America have all had large declines in the absolute number of people in extreme poverty since 2005. The important exception to this pattern is Sub-Saharan Africa, where continued high rates of population growth have more than offset the declines in the proportion of the population in poverty. The absolute number of people in extreme poverty in Africa grew by about 35% between 1990 and 2005. The increase since then has been at a slower rate, with the absolute number in extreme poverty growing by 5% between 2005 and 2019.

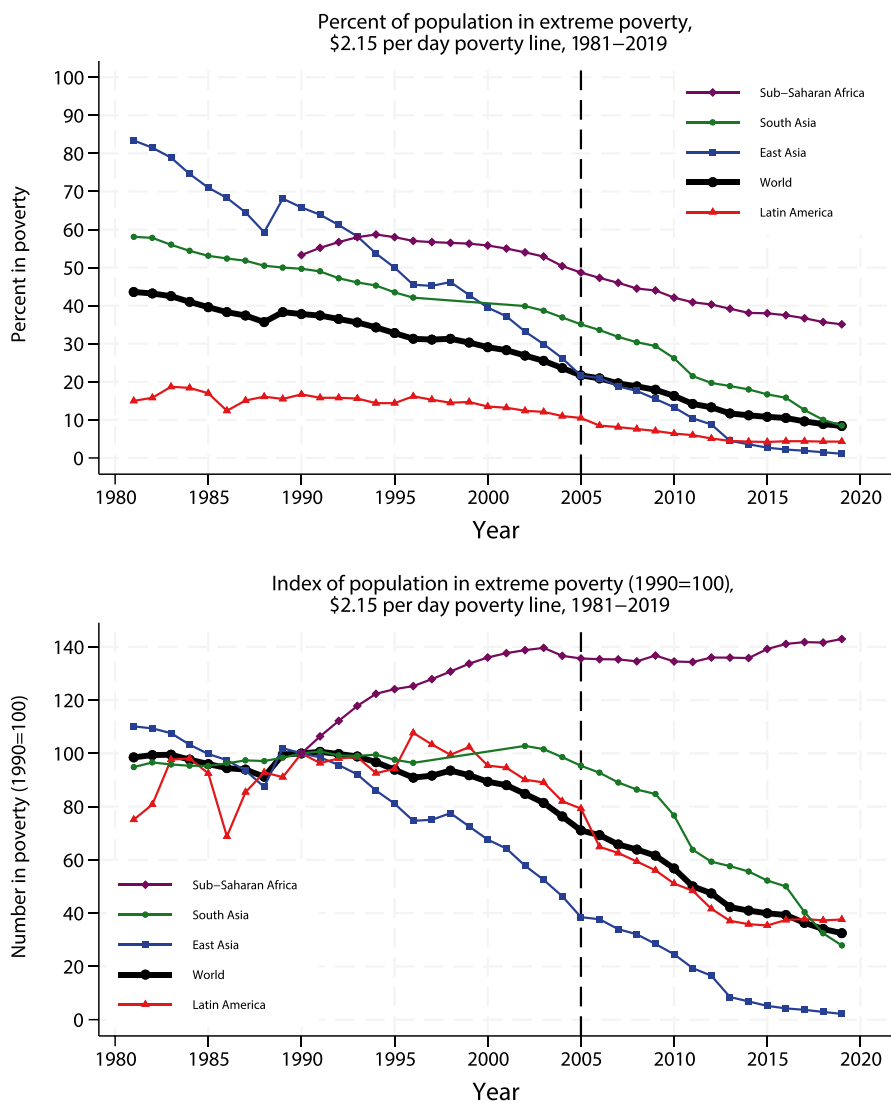


Fig. 5 Percentage of population in extreme poverty and index of total population in extreme poverty (1990=100), 1981–2019, using World Bank’s \$2.15 consumption per person per day poverty line. *Source:* Constructed using data downloaded from World Bank (2023a)

These estimates predate the impact of COVID-19, which has offset some of the gains in poverty reduction. World Bank economists estimate that global poverty increased in 2020, the first increase in decades, and that high food prices would further slow progress in poverty reduction in 2022 (Mahler et al., 2022). As with food and commodity prices, it seems unlikely that these setbacks induced by the global pandemic and the war in Ukraine are signs that decades of progress in reducing

poverty and hunger have come to an end. Hopefully, these are temporary setbacks and in the long run we will return to the steady progress in reducing poverty and hunger that has been the dominant trend of the last 60 years.

The challenge of climate change

As discussed in Lam (2011), one area in which the history of the last 60 years is not reassuring is climate change. This was true in 2011, and nothing in the intervening years has significantly reduced the threats posed by climate change to progress in all of the areas discussed above. There has also been no real change in the underlying reasons for why we have had worsening environmental outcomes at the same time that we have made enormous progress in reducing poverty and hunger. Challenges such as food production and resource scarcity lend themselves to responses based on market signals. Higher food prices induce increased production and new agricultural technologies. Higher resource prices lead to innovation and substitution of alternative materials for scarce metals. As pointed out in the World Bank's assessment of climate change and economic development (World Bank, 2010), "climate change is created by a large- scale negative externality" — there is, for the most part, no private cost incurred by those who produce greenhouse gases. As a result, there is no simple market mechanism to solve the climate challenge, at least not without interventions that create market mechanisms (such as carbon taxes or cap-and-trade systems) where they do not naturally exist. Market mechanisms do exist to spur adaption to climate change. For example, there are market incentives to develop innovations such as drought-tolerant crops. Mitigating the fundamental drivers of climate change, however, will require coordinated public action that goes beyond natural market forces.

The links between population growth and climate change are complex, and it is impossible to do justice to them here. One thing that is clear is that climate change has the potential to have severe effects in the countries that are already most affected by hunger and poverty. Most of these countries are heavily dependent on agriculture, and many are in areas such as the Sahel that are facing severe consequences of climate change (World Bank, 2010, IPCC 2022).

While the poorest countries of the world are among those most affected by climate change, the contribution of those countries to climate change is small. When the world grew from 7 to 8 billion people between 2011 and 2023, the additional billion people were added in some of the poorest countries in the world, countries which also have some of the smallest carbon footprints (Bruckner et al., 2022; World Bank, 2010). Baker and Mitchell (2020), updating earlier work by Dercon (2014), estimate that the world's 52 poorest countries produced only 1.6% of global CO₂ emissions in 2014, even though they accounted for 19% of world population.

Taking a similar approach to that of Dercon (2014), Table 1 shows the relationship between the share of global CO₂ emissions between 2011 and 2020 to the share of population in 2020 for a set of countries and country groupings. The countries are the nine countries with the largest populations in 2020, along with Niger, which had the highest population growth rate in 2020. Niger, which had the fastest annual

Table 1 Population growth, share of world population, and share of world CO₂ emissions

Country/area	Population growth rank (1 = fastest)	Annual population growth rate (2019–2020)	Share of world population (2020)	Share of world CO ₂ emissions (2011–2020)	CO ₂ share/ population share	GDP per capita (US\$)
Niger	1	3.77%	0.31%	0.01%	0.02	\$ 913
Nigeria	24	2.54%	2.64%	0.37%	0.14	\$ 5416
Pakistan	47	1.98%	2.83%	0.58%	0.20	\$ 5711
Indonesia	95	1.07%	3.51%	1.67%	0.48	\$ 11,490
Bangladesh	100	1.00%	2.11%	0.22%	0.11	\$ 4254
India	102	0.99%	17.70%	6.78%	0.38	\$ 6532
Brazil	122	0.71%	2.73%	1.51%	0.56	\$ 14,157
USA	132	0.59%	4.25%	16.31%	3.84	\$ 55,460
China	146	0.39%	18.47%	30.22%	1.64	\$ 12,714
Russia	173	0.04%	1.87%	5.01%	2.68	\$ 24,795
<i>Country groups</i>						
Africa		2.49%	17.20%	4.04%	0.23	\$ 4837
Asia		1.35%	59.52%	58.24%	0.98	\$ 11,115
Europe		0.55%	9.61%	17.30%	1.80	\$ 31,729
North America		1.26%	7.60%	20.00%	2.63	\$ 49,722
South America		1.74%	5.53%	3.46%	0.63	\$ 14,082
25% fastest population growth		2.70%	19.38%	3.01%	0.16	\$ 4342
25% slowest population growth		0.32%	11.15%	20.42%	1.83	\$ 28,194
Poorest 25%		2.56%	11.42%	0.75%	0.07	\$ 2047
Richest 25%		0.31%	16.60%	42.60%	2.57	\$ 44,520
World Bank low-income		2.64%	8.77%	0.49%	0.06	\$ 1,743
World Bank high-income		0.30%	15.09%	40.70%	2.70	\$ 43,553

Based on data from Our World in Data (2022). Population growth measured 2019–2021. CO₂ emissions are cumulative 2011–2020. GDP per capita in 2018

population growth rate in the world at 3.8%, accounted for 0.3% of world population in 2020, but only accounted for 0.01% of world CO₂ emissions in 2011–2020. Nigeria accounted for 2.6% of the world's population, but only accounted for 0.4% of the world's CO₂ emissions. Column 6 shows the ratio of a country's share of total CO₂ emissions to its share of population. This ratio is 0.02 for Niger, meaning that Niger's share of CO₂ is 1/50 its share of population. This ratio rises significantly as we move down the table to countries that are richer and have lower rates of population growth. The US ratio of 3.8 is by far the highest among the world's nine largest countries. The USA produced 16.3% of the world's CO₂ emissions, but only had 4.3% of the world's population.

Looking at regional groupings, Africa, with by far the highest population growth rate, accounted for 17% of world population, but only accounted for 4% of global CO₂ emissions. Asia produced almost exactly the same share of CO₂ emissions as its share of population. Europe produced 1.8 times more CO₂ than its share of population, while North America produced 2.6 times more CO₂ than its share of population.

If we take the 25% of countries with the highest rates of population growth in 2020, they accounted for 3% of CO₂ emissions, but accounted for 19.4% of world population. The poorest 25% of countries accounted for 11.4% of world population, but only 0.8% of CO₂ emissions. The richest 25% of countries accounted for 16.7% of world population and 42.6% of global CO₂ emissions.

Given the patterns in Table 1, it is clear that the countries with the highest population growth rates, which are also among the poorest countries, could double their populations and double their per capita GDP without significantly increasing global CO₂ emissions. High rates of population growth in Africa have an almost negligible impact on global CO₂ emissions. As pointed out by Dercon (2014), generating economic growth and poverty reduction in these countries will have minimal impact on climate change. And economic growth and poverty reduction may well lead to slower population growth, further limiting the impact of economic development on CO₂ emissions. At the same time, these countries are likely to experience some of the most severe impact of climate change (IPCC 2022). Addressing climate change requires action directed at high-income and middle-income countries. While dealing with climate change might be easier if the world had 3 billion rather than 8 billion people, it was not the addition of 5 billion people since 1960 that was the main cause of global warming. It is consumption patterns in high- and middle-income countries that play the major role in carbon emissions, and there will be a need for strong action to combat climate change no matter what happens to world population.

Conclusion

As the world added another billion people between 2011 and 2023, the world continued to experience progress in important areas such as food production per capita and poverty rates. Food production grew faster than population in every major region, continuing the trends that have existed since the early 1960s. The proportion of the population in poverty fell in every major region. The decline in the poverty rate was not large enough to offset high rates of population growth in Africa, however,

causing Africa to be the one region that had an increase in the absolute number of people in poverty. Food prices and other commodity prices declined for most of the period 2011–2019, but then increased sharply as the COVID-19 pandemic disrupted global production and supply chains.

Has the world survived the population bomb, as I argued in Lam (2011)? The period since 2011 continues to support an optimistic picture in many dimensions. Poverty has continued to fall, food production per capita has continued to rise, and we have not faced major resource shortages. Considering that we have added 5 billion people to the world since 1960, this must be viewed as a major global success story. Not all trends are positive, however. Food production has slowed in some regions and food prices are at some of the highest levels seen since the 1970s. Most importantly, climate change threatens to upend progress in all of the areas discussed in this paper, with particularly negative impacts in many of the poorest countries in the world. As the paper has shown, population growth has played a fairly minor role in climate change, however, and that will continue to be the case. High-income countries, which have mostly had low population growth rates, have accounted for the vast majority of CO₂ emissions. The countries with the highest population growth rates, which are also among the poorest, account for a very small fraction of global CO₂ emissions. Increasing economic growth in these countries, with resulting declines in poverty, will not cause a significant worsening of climate change, even with high rates of population growth. The real challenge is to adopt policies directed at high-income and middle-income countries that will reduce global warming going forward, a change that will greatly improve the prospects for continuing the progress of the last 60 years in reducing hunger and poverty in low-income countries.

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Data Availability All of the data used for the paper are publicly available using the information provided in the text, references, and footnotes.

Declarations

Conflict of interest The author declares no competing interests.

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